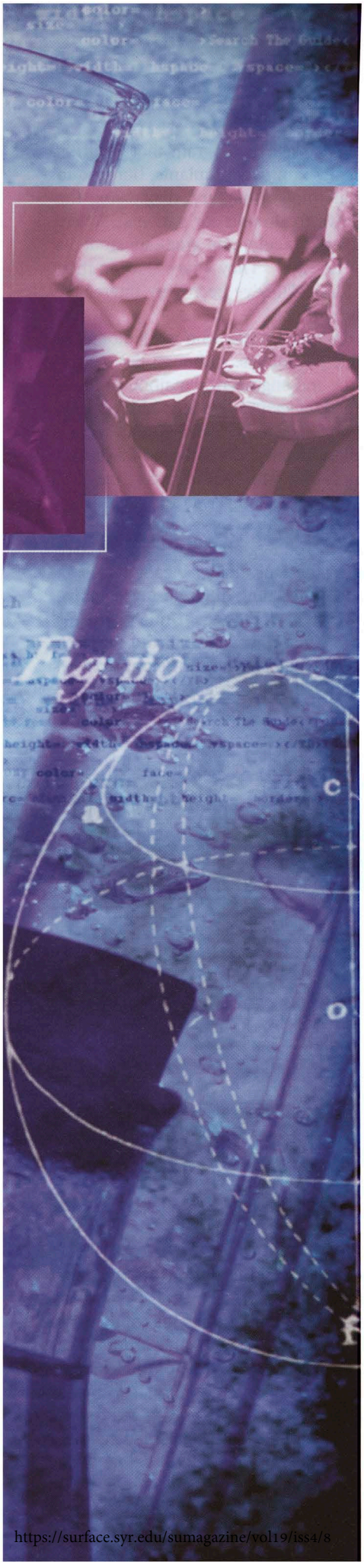
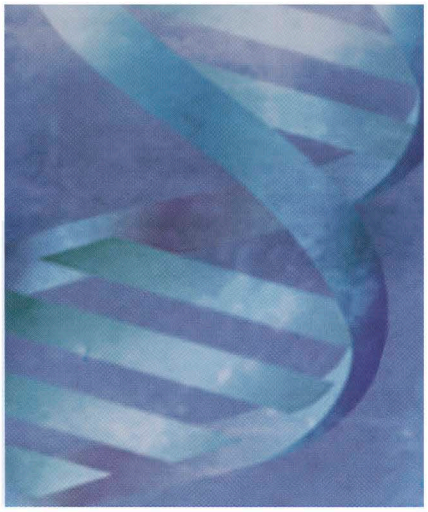
Illustration by Alicia Buelow





A Head Start

Undergraduates immersed in research come away with far more than just practical experience

By Christine Yackel

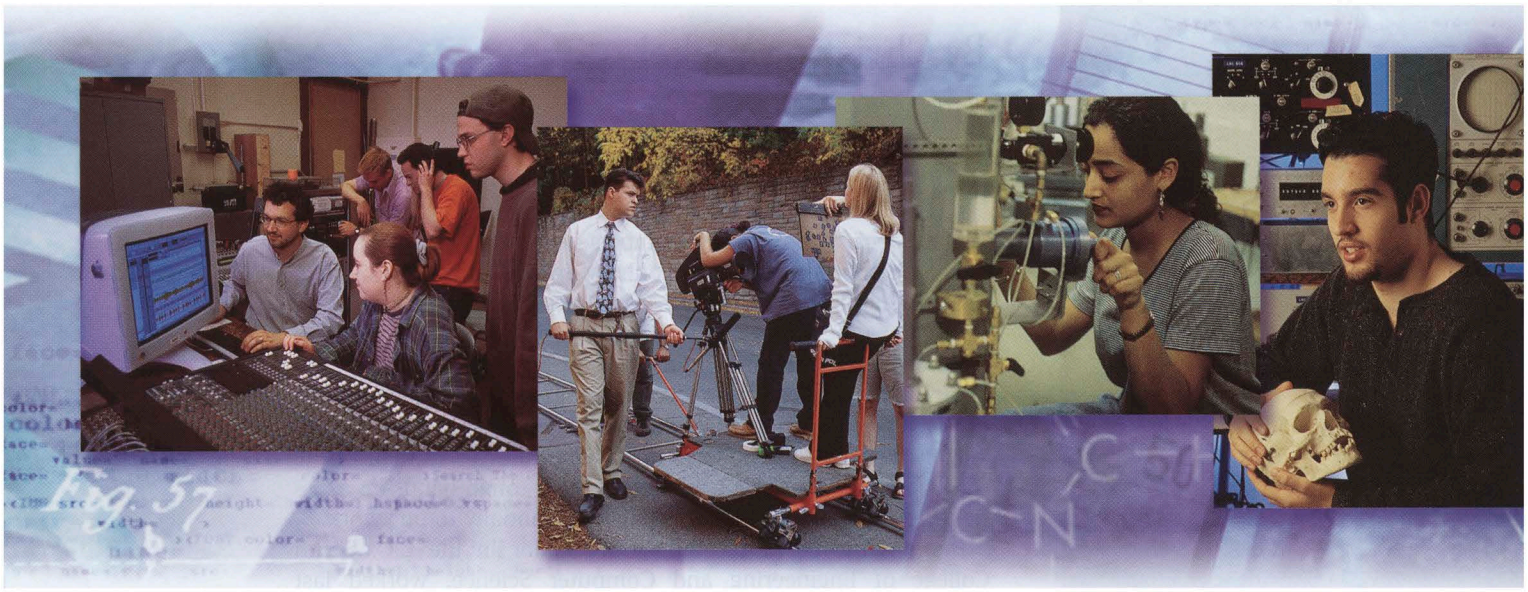
When the Institute for Sensory Research (ISR) first opened its laboratories to undergraduate researchers more than a decade ago, faculty members were concerned their work would be impeded. Quite the contrary. Instead of being a burden, the students have proven to be an asset. "The benefits far outweigh the time and effort it takes to work with undergraduate researchers," says Robert Smith, director of the institute, an interdisciplinary research center focusing on the structure and function of human and animal sensory systems. "Faculty get a lot of satisfaction from helping students apply what they've learned in the classroom, and students gain confidence through hands-on experience. And the students contribute substantially to our work."

Brian Kelly '05, a bioengineering major in the L.C. Smith College of Engineering and Computer Science, worked last semester in the ISR lab of bioengineering and neuroscience professor Laurel Carney, researching auditory psychophysics, or how the brain picks up and processes sounds. "I was developing a computer program to produce intervals of different noises to study how the brain detects information in the presence of noise," Kelly says. He also has a personal interest in the research: He has cochlear implants in both ears and volunteers as a test subject for the research. "I hope to understand why I'm not hearing as well as I would like, and then use this knowledge to develop technology to help make it easier for people with implants to hear," he says. "The combination of being a subject and a researcher is a huge advantage."

Kelly hopes his work in the new cochlear implant research program that Smith is developing at ISR will lead not only to technologically improved implants, but also to greater success for physicians performing cochlear implant surgery, diagnosing the causes of hearing loss, and developing more effective treatments for patients. "There were times when I was stuck with my experiments, but faculty and graduate students were always there to troubleshoot the problems," he says. "They enjoy sharing their research and are always curious about what I'm doing. They've been very interactive and enthusiastic, and I look forward to working with them."

Kelly is one of hundreds of Syracuse University undergraduates who work alongside faculty on research projects in a variety of academic disciplines. Although the majority of undergraduates involved in research are science and engineering majors, students work with faculty in every school and college of the University. "Undergraduates who work closely with faculty expand their minds beyond classroom learning and deepen their intellectual skills," says Eric Holzwarth, assistant dean of the College of Arts and Sciences and director of its Undergraduate Research Program. "And faculty find that working shoulder-to-shoulder with undergraduates is an exciting way to teach. It's a wonderful thing to see."

Increasing the number of research opportunities for undergraduates is an effective way to ensure greater student success, according to the University's Academic Plan. "One way students develop critical thinking skills is by learning different investigative methodologies," says Vice Chancellor and Provost Deborah A. Freund. "Undergraduates at research universities have the opportunity to be actively engaged in the research process alongside faculty. As part of our student-centered research mission, we will enhance the integration of faculty research with the learning experiences of students."



Intrinsic Rewards

Undergraduates are not relegated to menial tasks in the laboratory; they are valuable members of a research group assigned to their own piece of a project. Peter Neuburger '03 has done genetics research with biology professor John Belote since his sophomore year. Working around his class schedule during the academic year and around the clock during the summers, Neuburger helped decipher the genetic code of the fruit fly, *Drosophila melanogaster*, a species with a high percentage of genes similar to those found in humans that have been implicated in various diseases. His efforts led to the discovery of a genetic mutation that affects the function of a highly conserved cellular structure called the proteasome. "Peter has made significant discoveries," Belote says.

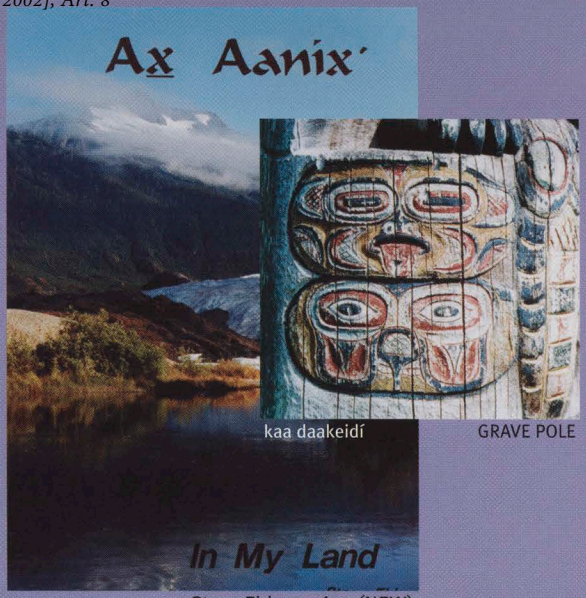
With Honor

The honors thesis experience offers additional depth and breadth to undergraduate degree programs

Integrating research into the undergraduate experience originated in the Honors Program, which was established in the College of Arts and Sciences in 1963 and went University wide in 1986. Thesis Project Honors, intended for upper-division students, offers additional depth and focus to a student's regular degree program through research and creative expression. It requires strong academic credentials and intense intellectual curiosity. "About 120 juniors are admitted to Thesis Project Honors each year," says Judy Hamilton, interim executive director of the Honors Program. "About half complete the program—a good rate compared with the national average."

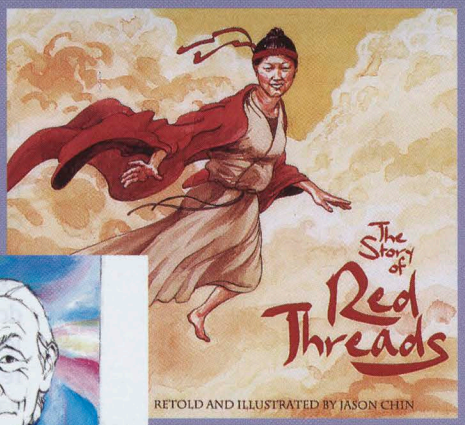
Upper-division students, who must complete written theses and give presentations at the end of their senior year, choose research topics and find faculty mentors, or find faculty mentors and design research projects together. Often a student will take on a piece of a faculty mentor's work. "Students in such schools as visual and performing arts and public communications, who must work within the medium of their majors, may write and produce a play, create a film documentary, write a television or radio script, or develop a unique art exhibition," Hamilton says. "We refer to all creative activities as research because the projects generate new knowledge for the students and tie their academic work together."

The honors thesis project experience can spark interest and launch students toward successful careers. Meg LeFauve '87, who completed a dual major in English and television-radio-film, examined the works of film director Ingmar Bergman in her honors thesis. She recently produced the film *The Dangerous Lives of Altar Boys* starring Jodie Foster. Brian Cohen '76, a speech communication major, used his project as a basis for his own communications consulting company, which he recently sold to the largest advertising firm in the country. Paul Finkelman '71 wrote his honors thesis on the case of Angelo Herndon, a young black man accused in 1932 of violating a pre-Civil War statute. Finkelman became a specialist in impeachment, slavery and freedom, historical racism, the Constitution, and antebellum American law. He went on to earn a Ph.D. in history from the University of Chicago and was later a Fellow in Law and Humanities at Harvard Law School. He is now the Chapman Distinguished Professor of Law at the University of Tulsa College of Law. "The honors program was one of the most important experiences for me at SU," Finkelman says. "It enabled me to do research for an entire year on a single topic, which led me to an academic career. I've now published more than 15 books and 80 scholarly articles. One of these days, I hope to get back to my SU honors thesis and at least get an article out of it, if not a whole book." **—Christine Yackel**

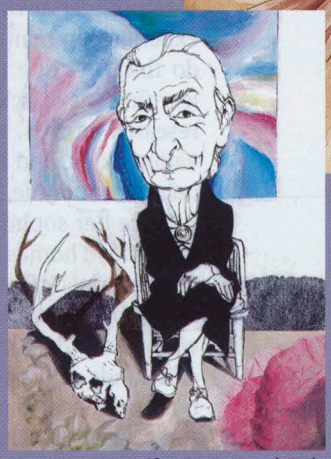


Stacy Eldemar '90 (NEW)


Howard Hordies '93 (VPA)



Jason Chin '01 (VPA)


Jennifer Szeto '00 (VPA)

Creative expression through photography, illustration, and portraiture is one of the ways students fulfill Thesis Project Honors requirements.

"We hope to publish his findings in a peer-reviewed journal and show his work as a poster presentation at a national conference." Neuburger is now mastering the intricate technique of dissecting tiny *Drosophila* larvae. "My previous discoveries were a continuation of what other students had done before me," he says. "As an advanced undergraduate researcher, I now have more ownership of my work. It's really exciting."

Biology majors are encouraged to get involved in research early on, but not all do so because of the long hours required to conduct experiments, analyze data, and prepare presentations, with little academic credit in return. For those who put in the effort, however, the rewards can be great. "Research requires dedication and commitment," says Professor Reed Hainsworth, undergraduate advisor in the biology department. "But it's a real plus if a student can offer something extra on his or her resume or graduate school application, and faculty write better letters of recommendation if they know a student well."

Before enrolling at SU, Neuburger knew undergraduates could get involved in research, so he started hounding Belote as soon as he arrived on campus and became part of Belote's research group in his sophomore year. Belote says students who want

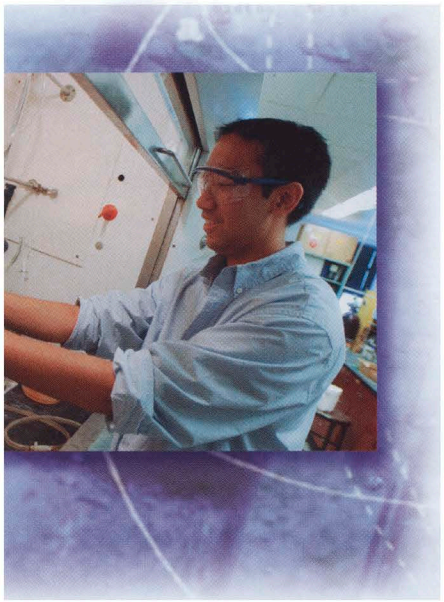
to do genetics research with him must take the initiative and approach him, as he judges their interest level by their tenacity. "Performance in the classroom is not directly related to research ability," he says. "I look for students who show enthusiasm and dedication. Peter was very persistent."

Neuburger always wanted to do research, but after logging long hours in the lab and experiencing many frustrating moments, he began to ask himself, "Why did I want to do this?" In due time he realized undergraduate research is about much more than learning new scientific methods and terminology—it's about understanding the research process, which includes completing literature reviews, developing keen observation skills, and acquiring infinite patience. "I've learned that doing research is like a microcosm of life," Neuburger says. "Now I focus on the journey instead of the goal."

Since her sophomore year, biochemistry major Karleen Adkins '03 has worked with Professor Thomas Fondy on a project to find a species that can be used as a model for clinical trials of new drug treatments for humans. "When compared to mice, fish are more abundant and would require smaller doses of medication," Adkins says. "But first we have to demonstrate whether the fish respond in similar ways as humans to specific kinds of cancer." The experiment involves dividing the fish into groups that have tumors, those that have pigmented skin but no tumors, and those that are normal. After plotting their survival rate over two years, Adkins and other undergraduate researchers examine every fish for evidence of cancer in the internal organs. When the

experiment is completed, the students will have processed and analyzed more than 100 fish. The data they collect will eventually be published, and the students will be credited as co-authors. "I'll be published before I'm 21," Adkins says. "This research experience fed my desire to go to medical school. Last summer my only job was to analyze fish and study for the MCATS."

Not all scientific research takes place in the laboratory. Psychology majors, for instance, learn the scientific method to describe, explain, predict, and change human behavior. Following an apprenticeship model, students seek out faculty mentors to work with them on research, teaching, and clinical service activities as participants in the Allport Project, an initiative designed to enhance learning opportunities for psychology majors. Together they set learning goals and identify appropriate projects, such as examining the effectiveness of drug and alcohol abuse treatment programs or studying how people cope with the stress of disease. Projects may include writing a research proposal, designing a survey or questionnaire, coding and collecting data, or developing a scientific poster presentation. "Mistakes do happen, but faculty members keep things on target," says Professor Jerome Dusek, director of undergraduate studies in the Department of Psychology. "Those of us who chose the teaching profession share the joy of watching young people learn—it's an intrinsic reward."



Educated Choices

The Undergraduate Research Program in the College of Arts and Sciences offers small grants to help students develop independent research projects during the academic year and supports undergraduate researchers over the summer through the Ruth Myers Scholars program and the Korczynski-Lundgren Award for biology students. As a National Science Foundation-designated Research Experience for Undergraduates (REU) site, the chemistry department sponsored 22 undergraduate researchers last summer. Five of the students were SU chemistry majors, others were from colleges and universities across the United States, and one student was from Turkey.

During the 10-week summer program—for which a three-year renewal application has been submitted to the National Science Foundation with substantial matching funds from SU—students learn about basic scientific research in organometallic, inorganic, physical, biological, and organic chemistries; and nanomaterials, spectroscopy, crystal structure analysis, and the preparation of new molecules. "The REU program's main goals are to help undergraduate students make educated choices concerning research careers, and to encourage students to consider a graduate education," says Professor Karin Ruhlandt-Senge, director of the program. "REU students have a head start because they understand the research process."

Instead of returning to his home in Anchorage, Alaska, for the summer, chemistry major Nathaniel Reyes '04 stayed on campus to participate in the REU program. He worked in Professor James Kallmerten's laboratory, creating molecules that will, in effect, filter radioactive wastewater. Reyes worked in the laboratory all day, every day, which was a big change from the 10 hours a week he normally put in during the academic year. "The summer research experience opened my eyes to what I can do and showed me what working in industry or going to graduate school would be like," Reyes says. "I haven't decided if I'll go to graduate school or apply to medical school, but I've discovered I enjoy working in the lab. Faculty members are very encouraging, and you can tell they love what they do—that's really cool."